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Published:
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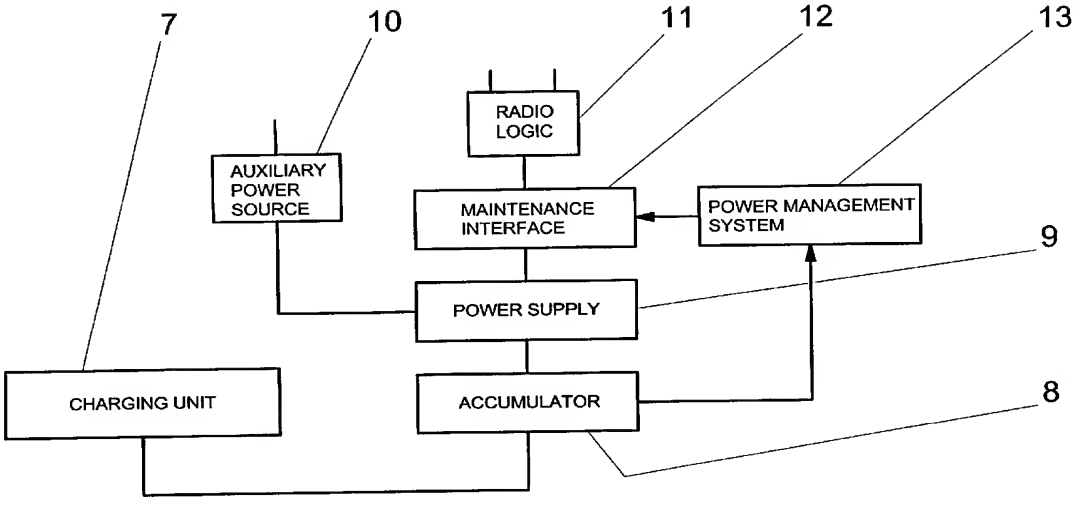
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** AN ARRANGEMENT AND A METHOD FOR MANAGING POWER OF A TELECOMMUNICATION NETWORK ELEMENT



(57) **Abstract:** This invention relates to electronic devices in general, and more particularly, to a new type of solution for managing power of a cordless telecommunication network element, such as a Radio Fixed Part (RFP) or a Wireless Relay Station (WRS). With the help of the invention it is possible to save power to make the most hours with a given amount of power, either a battery charge or the power received from a solar panel during the sunlight period of the day. The solution according to the invention can be used in cordless communications systems such as Digital Enhanced Communications System (DECT).

WO 01/82641 A1

AN ARRANGEMENT AND A METHOD FOR MANAGING POWER OF A TELECOMMUNICATION NETWORK ELEMENT

This invention relates to electronic devices in general, and more particularly, to a new type of solution for managing power of a telecommunication network element, such as a Radio Fixed Part (RFP) or a Wireless Relay Station (WRS). The solution according to the invention can be used in cellular mobile communications systems as well as in cellular cordless communications systems such as Digital Enhanced Communications System (DECT).

The use of wireless telecommunication has exponentially increased. People as users demand more and more wireless applications, that are not only easy and comfortable to use, but also fast and flexible to install an take into use. New wireless telecommunication applications are replacing many of the conventional wireline system applications.

In wireless telecommunication systems, the used equipment is fed by a local power source, e.g. a battery. The usage time of a fully charged battery depends on the power capacity of the battery and the power consumption of used system. The battery capacity is limited and the battery has to be charged regularly. Users anyhow demand a wireless telecommunication system that provides the standard service that is expected from the system.

In the following, the prior art solutions will be described in more detail with reference to the accompanying drawings 1-2, in which:

Figure 1 is an illustrative diagram showing a cordless telecommunication system according to prior art,

Figure 2 is an illustrative diagram showing an arrangement for charging a cordless

telecommunication network element according to prior art.

Figure 1 is an illustrative diagram showing a cordless telecommunication system according to prior art. A cordless telecommunication system according to prior art consists of a fixed part 1, such as Central Control Fixed Part (CCFP) 1, a number of Radio Fixed Parts (RFP's) 2, 3, 4 communicating with a number of users each having a Portable Part (PP) 6, such as a cordless phone 6.

In a typical cordless telecommunication system according to prior art there may also be a number of Wireless Relay Stations (WRS) 5, which can for instance be located in the remote areas of the network between the users and a Radio Fixed Part (RFP) 2. Wireless Relay Station (WRS) 5 is seen from the side of a Radio Fixed Part (RFP) 2 as a Portable Part (PP), and correspondingly WRS 5 is seen from the side of a Portable Part (PP) 6 as a Radio Fixed Part (RFP).

Wireless Relay Station (WRS) 5 is typically fed by a local power source, e.g. a battery. The capacity of the battery is limited and the battery has to be charged regularly. The charging can be provided with, for instance, solar panels or a wind powered charging arrangement. The WRS unit 5 consumes a lot of power since it constantly provides service to 12 available channels.

Wireless Relay Station (WRS) 5 is often used as a stand-alone device in areas where common (230 V AC) electricity outlet might not be available such as e.g. parking lots. The usage time of a fully charged battery depends on the power capacity of the battery and the power consumption of the Wireless Relay Station (WRS) 5. In some cordless telecommunication networks also a Radio Fixed Part (RFP) 2 can in some cases be self powered, thus having also strict power consumption requirements.

Figure 2 is an illustrative diagram showing an arrangement for charging a cordless telecommunication network element according to prior art. A arrangement for charging a cordless telecommunication network element according to prior art consists of a charging unit 7, an accumulator 8, a power supply unit 9, a maintenance interface 12, a radio logic unit 11 and optionally an auxiliary power source 10.

The power is supplied to the power supply unit 9 by an accumulator 8 or an auxiliary power source 10. The power supply unit 9 feeds the necessary power to the radio logic unit 11 through a maintenance interface 12. The accumulator 8 is charged by a charging unit 7, such as solar panels 7 or a wind powered charging arrangement 7. The presented arrangement can be used, for example, for charging a Wireless Relay Station (WRS).

The current prior art arrangements for charging a cordless telecommunication network element have many disadvantages. The power needed by the network element is relatively high which in turn increases the size of the battery. The charging unit e.g. solar panels also have to be large enough in order to provide the necessary charge for the battery. Size of the battery and of the charging unit also affects the size and the weight of the whole device.

The enterprises acquiring the cordless telecommunication networks place strict requirements on the performance of the network. The network has to meet the requirements in relation to the required services and to technical performance. There is further a demand for lower energy consumption than in the prior art networks both due to economical and environmental reasons. The devices in the cordless telecommunication network also have to be easy to install and maintain.

From the side of the users of a cordless telecommunication network as well as the enterprises acquiring a network there are also some expectations in regard to the size and outlook of the network devices. The size and weight of the battery and of the charging unit is expected to be relatively small and light.

In the view of the previously mentioned expectations there so far has not been provided an adequate solution for maintaining power of a cordless telecommunication network element that would not increase the size and outlook of the network device or reduce the performance. There is an increasing demand for a new type of solution for managing power of a cordless telecommunication network element.

The aim of this invention is to overcome the drawbacks of the prior art solutions and to provide new type of solution for managing power of a cordless telecommunication network element.

According to the first aspect of the present invention there is provided an arrangement for managing power of a cordless telecommunication network element comprising a radio logic unit, a power supply unit feeding power to the radio logic unit through a maintenance interface, an accumulator supplying power to the power supply unit, and a charging unit charging the accumulator, which is characterized by that the system also comprises a power management system, which is used to dynamically control the available total power capacity and the power consumed by the radio logic unit, and to reduce power consumed by the radio logic unit by switching OFF the radio and the associated electronics of the radio logic unit. There is also provided a method for managing power of a cordless telecommunication network element, which is characterized by that the method comprises the steps of reading the input parameters by the power management system, selecting

the service level of the cordless telecommunication network element, deciding the number of enabled channels in the network element, and recording history data of the behavior of the cordless telecommunication network element.

Complete understanding of the system and method of the present invention may be obtained by the preferred embodiments that follow, taken in conjunction with the accompanying drawings, wherein:

Figure 1 is an illustrative diagram showing a cordless telecommunication system according to prior art,

Figure 2 is an illustrative diagram showing an arrangement for charging a cordless telecommunication network element according to prior art,

Figure 3 is an illustrative diagram showing an arrangement for managing power of a cordless telecommunication network element according to the present invention,

Figure 4 is a flowchart diagram of a method for managing power of a cordless telecommunication network element according to the present invention.

The prior art solutions have been described in drawings 1-2. In the following, the solution according to the present invention will be described in more detail with reference to the accompanying drawings 3-4.

Figure 3 is an illustrative diagram showing an arrangement for managing power of a cordless telecommunication network element according to the present invention. A arrangement for charging a cordless telecommunication network element according to the present invention consists of a charging unit 7, an accumulator 8, a power supply unit 9, a maintenance interface 12, a power management system 13, a

radio logic unit 11 a and optionally an auxiliary power source 10.

The power is supplied to the power supply unit 9 by an accumulator 8 or an auxiliary power source 10. The power supply unit 9 feeds the necessary power to the radio logic unit 11 through a maintenance interface 12. The accumulator 8 is charged by a charging unit 7, such as solar panels 7 or a wind powered charging arrangement 7. In an arrangement according to the present invention there is also a power management system 13, which is used to control the power consumed by the radio logic unit 11. The presented arrangement can be used, for example, for charging a Wireless Relay Station (WRS).

With the help of the arrangement according to the present invention it is possible to provide the best possible service with a given amount of power, i.e. either a battery charge or the power received from a solar panel during the sunlight period of the day. The power management system 13 according to the present invention is used to reduce power consumed by the radio logic unit 11 by switching OFF the radio and the associated electronics of the radio logic unit 11 e.g. RFP as much as possible.

The switching OFF the radio will naturally degrade the available capacity. However, the power management system 13 is used to dynamically control the available total capacity. An power management system 13 may disable most of the channels and keep the number of enabled channels, i.e. the traffic capacity, only a limited number higher than the actual number of used traffic channels, up to a certain maximum. The maximum may be the physical number of channels or it may be set to a lower value at some moments.

Figure 4 is a flowchart diagram of a method for managing power of a cordless telecommunication network element according to the present invention. In a method according to the present invention there is first the input parameters are read 14 by the power management system 13. As the input parameters have been read 14, next there is selected 15 the service level of the cordless telecommunication network element. When the service level has been selected 15, then the number of enabled channels in the network element is decided 16. Thereafter history data of the behavior of the cordless telecommunication network element is recorded 17 by the power management system 13 for the basis of the future power management.

In a solution for managing power of a cordless telecommunication network element according to the present invention there can be an internal clock applied for generating traffic patterns. The internal clock may be used to pre-select certain times for certain level of service 15. The clock may also used to build up statistics 17 about the busy hours and the moments of little traffic. This information can then dynamically be used in pre-selecting the level of service e.g. to prioritize the periods of high traffic. This allows the power management system 13 to predict the amount of power needed to adapt the offered traffic capacity to best meet the needs of the network element.

In a solution according to the present invention there may also be applied a sensing device to measure the amount of power received into the battery and the amount of power used from the battery. Together with the internal clock and knowledge about the total battery capacity the power management system 13 may form different power management patterns in time in order to provide the traffic service required and allowed by the battery power. These power management patterns in time may indicate when to cut back

on power, depending on the actual battery charging level and the capacity needed, derived from the actual service requests and on the history data, correlated to the time.

In a solution according to the present invention, for example when no traffic is present and battery charge is not high, the power management system 13 may instruct the cordless telecommunication network element, e.g. RFP, to transmit two beacon channel bearers and set blind slot mask to all other bearers. This indicates that all timeslots are blind i.e. unavailable except for these two slots. The network element is then required to receive only during these timeslots, so the network element receiver can be switched OFF for 10/12 of the RX half-frame. As soon as this timeslot is used for traffic, the network element may enable one more slot when battery power is not too low. Further power reduction can be achieved by closing down one of the two beacon bearers when either battery power is lower than a threshold or in known slow hours.

In a business cordless telecommunication network most calls are usually made between 9:00 and 18:00. In a solution for managing power of a cordless telecommunication network element according to the present invention, the internal clock of the network element, e.g. RPF, may be set to reduce service outside busy hours.

When a cordless telecommunication network is charged by solar power, typically acquired in the hours around noon, with solar panels 7 as a charging unit. In this case the power management system 13 of the network element, e.g. RPF, may divide the available battery power by the amount of hours until the next recharge by the sun. The power management system 13 may decide that the power is only sufficient to supply X capacity. Resulting from this the network element may close down a number of timeslots or

even beacon bearers to restart service when either new power is received or the internal clock indicates that it is required to provide more service. In practice this could even mean that no service is provided during a part of the night when the power management system 13 decides that power must be preserved for higher priority hours, instead of wasted during idle hours and providing no service during busy hours.

In a solution according to the present invention the power management system 13 may dynamically change the service level by applying the Blind Full Slot information broadcast of the standard Digital Enhanced Cordless Telephone (DECT) networks. This feature indicates the unavailable channels at a point in time so the service level can be changed dynamically.

In a solution according to the present invention the power management system 13 may dynamically change the service level by applying the measurement of the RSSI-indicator (RSSI, Received Signal Strength Indicator) on idle channels of the standard Digital Enhanced Cordless Telephone (DECT) networks. The measured RSSI-indicator indicates e.g. that the quality of the channel is not optimal so the network element, e.g. RPF, can decide to change the channels.

RSSI measurement prevents the limited number of active channels to become blocked by interference, while some unavailable channels would offer a good quality. The power management system 13 may also use the RSSI measurement to decide temporarily to enable more channels until one with good quality is found and close down the channels with less quality.

The power management system 13 may use the RSSI measurement to decide to replace one channel by another by

disabling an active channel and enabling one of the unavailable channels, e.g. when the RSSI on the active channel is higher than the quiet threshold. This may be repeated until the RSSI measurement shows a quiet channel. This approach may jeopardize service but unlike the previous approach it does not consume more power, because the number of active channels stays equal during the procedure.

With the help of the invention it is possible to save power to make the most hours with a given amount of power, either a battery charge or the power received from a solar panel during the sunlight period of the day. The solution according to the invention is flexible to implement for example in Wireless Relay Stations (WRS) and in Radio Fixed Parts (RFP).

WHAT IS CLAIMED IS:

1. An arrangement for managing power of a cordless telecommunication network element comprising
- a radio logic unit (11),
- a power supply unit (9) feeding power to the radio logic unit (11) through a maintenance interface (12),
- an accumulator (8) supplying power to the power supply unit (9), and
- a charging unit (7) charging the accumulator (8),
characterized in that the system also comprises a power management system (13), which is used
- to dynamically control the available total power capacity and the power consumed by the radio logic unit (11), and
- to reduce power consumed by the radio logic unit (11) by switching OFF the radio and the associated electronics of the radio logic unit (11).

2. A power management arrangement according to Claim 1, **characterized** in that the power management system (13) disables most of the channels and keeps the number of enabled channels a limited number higher than the actual number of used traffic channels, up to the physical number of channels.

3. A power management arrangement according to Claim 2, **characterized** in that the maximum number of enabled channels may be set to a value lower than the physical number of channels.

4. A power management arrangement according to Claim 1, Claim 2 or Claim 3, **characterized** in that to the power management system (13) reads (14) the input parameters, selects (15) the service level of the cordless telecommunication network element, decides (16) the number

of enabled channels in the network element, and records (17) history data of the behavior of the cordless telecommunication network element.

5. A power management arrangement according to any of the Claims 1 to 4, **characterized** in that there is an internal clock applied for generating traffic patterns.

6. A power management arrangement according to Claim 5, **characterized** in that the internal clock is used to pre-select certain times for certain level of service (15).

7. A power management arrangement according to Claim 5, **characterized** in that the internal clock is used to build up statistics (17) about the busy hours and the moments of little traffic.

8. A power management arrangement according to any of the Claims 4 to 7, **characterized** in that there is a sensing device applied to measure the amount of power received into the battery and the amount of power used from the battery.

9. A power management arrangement according to Claim 8, **characterized** in that the power management system (13) forms different power management patterns in time.

10. A power management arrangement according to any of the Claims 4 to 9, **characterized** in that the power management system (13) instructs the cordless telecommunication network element to transmit two beacon channel bearers and set blind slot mask to all other bearers, when no traffic is present and battery charge is not high.

11. A power management arrangement according to Claim 10, **characterized** in that the power management system (13) closes down one of the two beacon channel bearers when either battery power is lower than a threshold or in known slow hours.

12. A power management arrangement according to any of the Claims 5 to 11, **characterized** in that the internal clock of the network element is set to reduce service outside busy hours.

13. A power management arrangement according to any of the preceding claims 1-12, **characterized** in that the power management system (13) of the network element divides the available battery power by the amount of hours until the next recharge.

14. A power management arrangement according to any of the preceding claims 1-13, **characterized** in that the power management system (13) changes the service level dynamically by applying the Blind Full Slot information broadcast of the standard Digital Enhanced Cordless Telephone (DECT) networks.

15. A power management arrangement according to any of the preceding claims 1-14, **characterized** in that the power management system (13) changes the service level dynamically by applying the measurement of the Received Signal Strength Indicator (RSSI) on idle channels of the standard Digital Enhanced Cordless Telephone (DECT) networks.

16. A power management arrangement according to Claim 15, **characterized** in that the power management system (13) uses the Received Signal Strength Indicator (RSSI) measurement to decide temporarily to enable more channels

until one with good quality is found and close down the channels with less quality.

17. A power management arrangement according to Claim 15 or Claim 16, **characterized** in that the power management system (13) uses the Received Signal Strength Indicator (RSSI) measurement to decide to replace one channel by another by disabling an active channel and enabling one of the unavailable channels.

18. A power management arrangement according to any of the preceding claims 1-17, **characterized** in that the power management system (13) is implemented in a Wireless Relay Station (WRS).

19. A power management arrangement according to any of the preceding claims 1-17, **characterized** in that the power management system (13) is implemented in a Radio Fixed Part (RFP).

20. A method for managing power of a cordless telecommunication network element, **characterized** in that the method comprises the steps of

- reading (14) the input parameters by the power management system (13),
- selecting (15) the service level of the cordless telecommunication network element,
- deciding (16) the number of enabled channels in the network element, and
- recording (17) history data of the behavior of the cordless telecommunication network element.

21. A power management method according to Claim 20, **characterized** in that there is an internal clock applied for generating traffic patterns.

22. A power management method according to Claim 20 or Claim 21, **characterized** in that there is a sensing device applied to measure the amount of power received into the battery and the amount of power used from the battery.

23. A power management method according to Claim 21 or Claim 22, **characterized** in that the internal clock of the network element is set to reduce service outside busy hours.

24. A power management method according to Claim 21, Claim 22 or Claim 23, **characterized** in that the available battery power is divided by the amount of hours until the next recharge.

25. A power management method according to any of the preceding claims 21-24, **characterized** in that the service level is changed dynamically by applying the Blind Full Slot information broadcast of the standard Digital Enhanced Cordless Telephone (DECT) networks.

26. A power management method according to any of the preceding claims 21-25, **characterized** in that the service level is changed dynamically by applying the measurement of the Received Signal Strength Indicator (RSSI) on idle channels of the standard Digital Enhanced Cordless Telephone (DECT) networks.

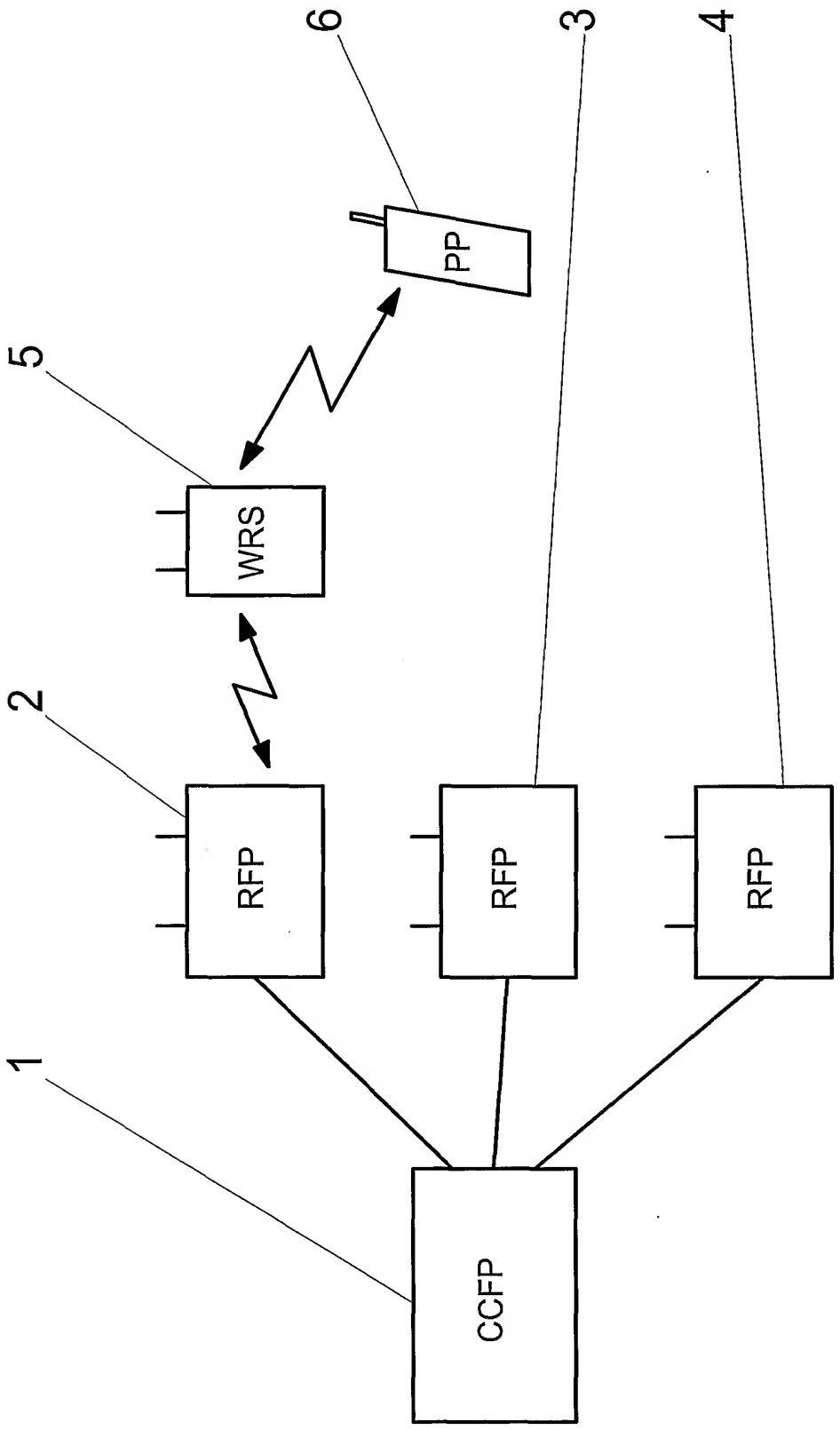


FIG. 1

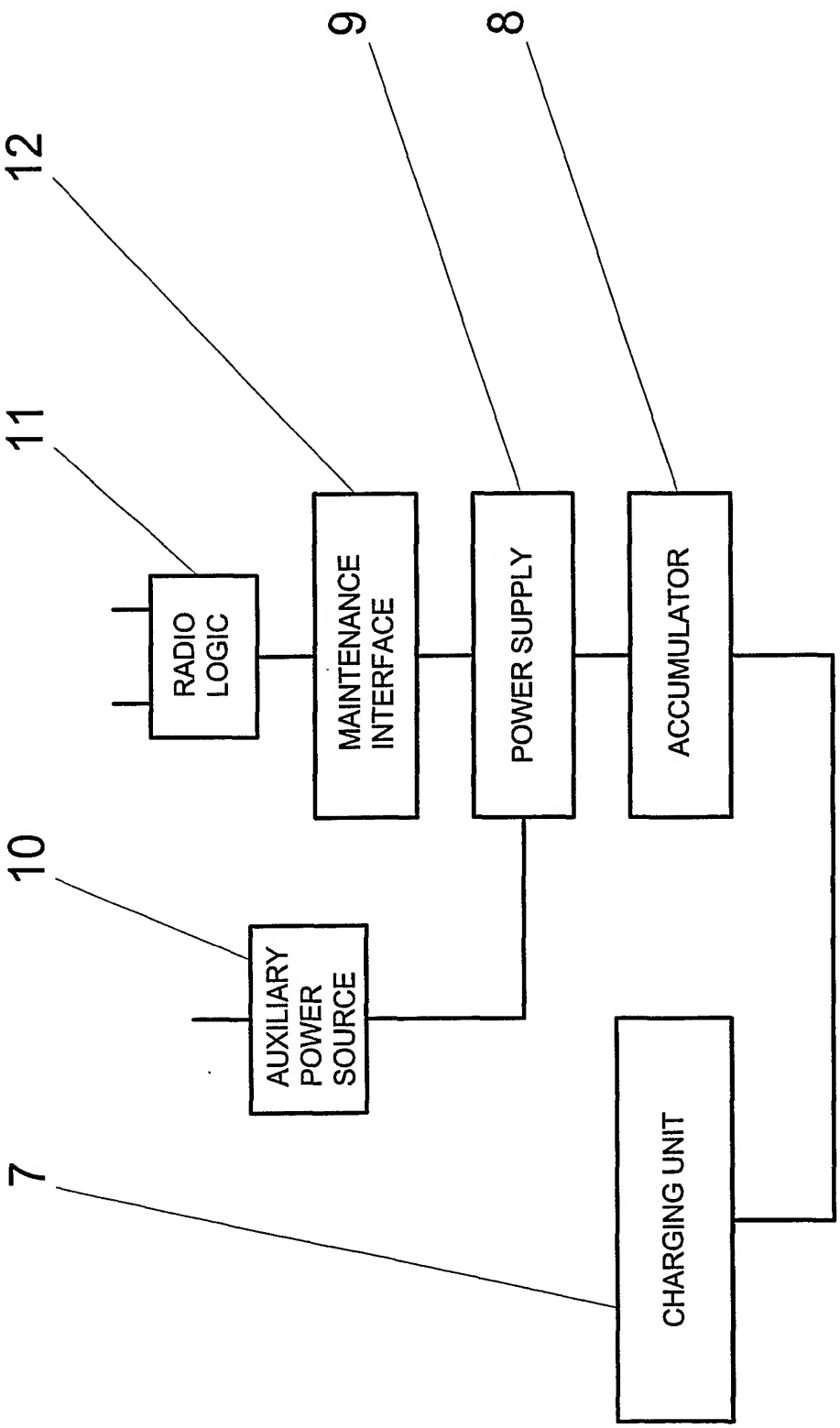

12
9
8
11
RADIO LOGIC
MAINTENANCE INTERFACE
POWER SUPPLY
ACCUMULATOR
10
AUXILIARY POWER SOURCE
7
CHARGING UNIT

FIG. 2

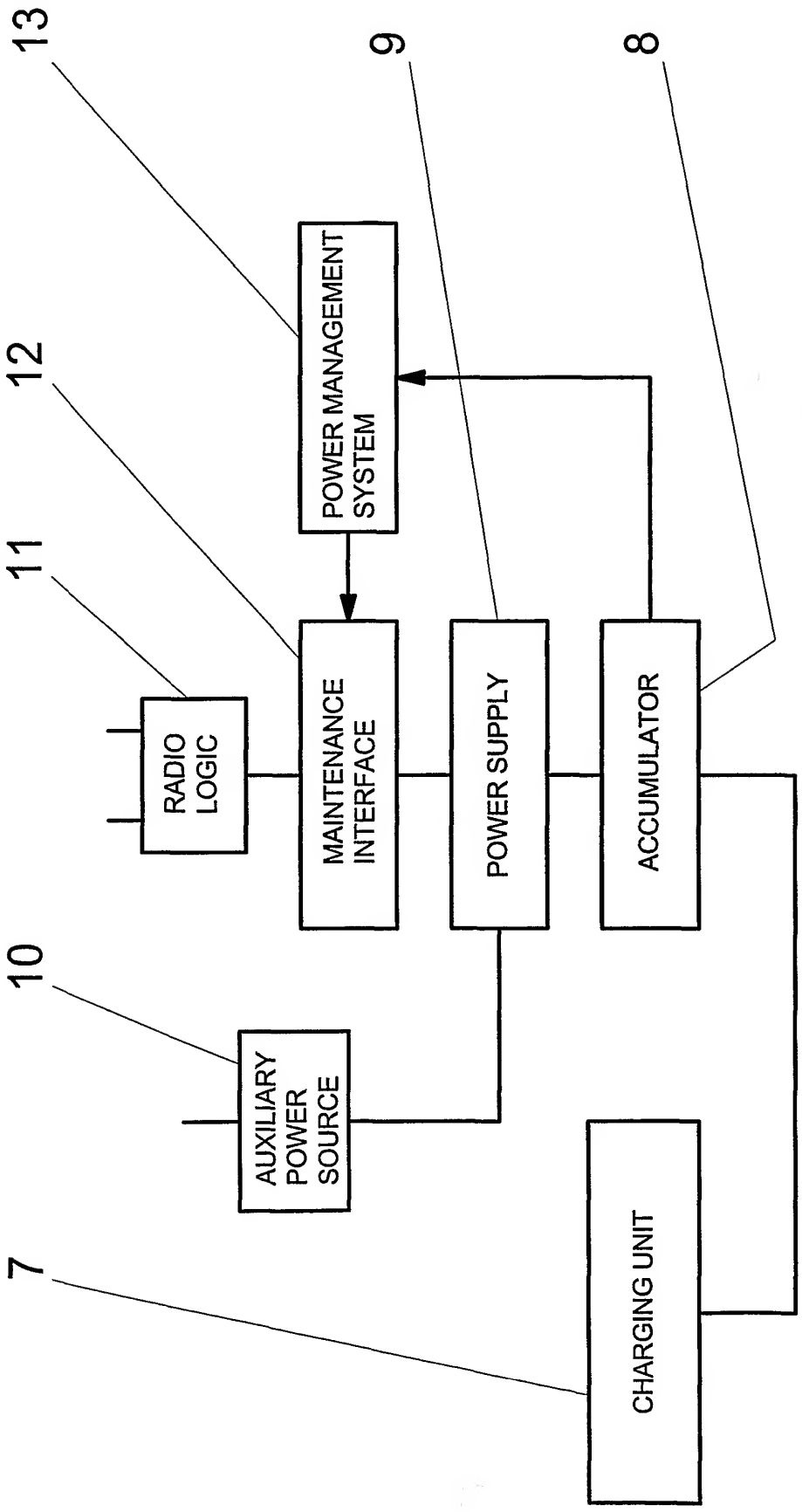

13
9
8
12
11
10
7
POWER MANAGEMENT SYSTEM
RADIO LOGIC
MAINTENANCE INTERFACE
POWER SUPPLY
ACCUMULATOR
AUXILIARY POWER SOURCE
CHARGING UNIT

FIG. 3

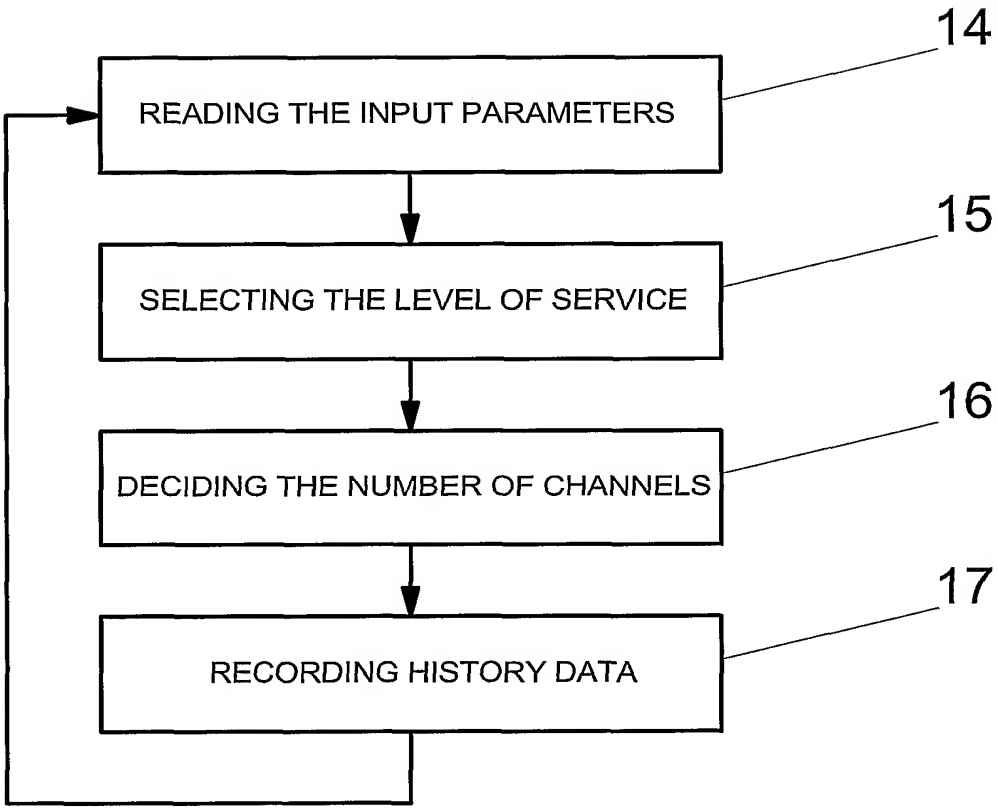

14
READING THE INPUT PARAMETERS
15
SELECTING THE LEVEL OF SERVICE
16
DECIDING THE NUMBER OF CHANNELS
17
RECORDING HISTORY DATA

FIG. 4

INTERNATIONAL SEARCH REPORT

Int nal Application No
PCT/EP 00/03754

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/30 H02J7/35

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q H04B H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 94 22239 A (ERICSSON TELEFON AB L M) 29 September 1994 (1994-09-29) page 3, line 6 -page 4, line 11	1-3,18, 19
Y		14-17
Y	PHILLIPS ET AL.: "Personal wireless communication with DECT and PWT" 1998 XP002156066 page 116, line 8 - line 15	14
X	GB 2 281 458 A (NOKIA TELECOMMUNICATIONS OY) 1 March 1995 (1995-03-01) page 2, line 4 - line 17	1
X	EP 0 287 305 A (NIPPON ELECTRIC CO) 19 October 1988 (1988-10-19) page 3	1

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 April 2001	08.05.01

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Bernedo Azpiri, P

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inte nal Application No
PCT/EP 00/03754

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 046 136 A (TOMIMURA KAZUO ET AL) 3 September 1991 (1991-09-03) column 2, line 46 -column 3, line 35	13
Y	US 5 212 831 A (SOLLENBERGER NELSON R ET AL) 18 May 1993 (1993-05-18) column 9, line 60 -column 10, line 9 column 12, line 20 - line 34	15-17

INTERNATIONAL SEARCH REPORT

Ir...tional application No.
PCT/EP 00/03754

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International Application No. PCT/EP 00 /03754

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-12,14,18-26

   Storing the past history of traffic in order to manage available power

   1.1. Claim : 14
   Use of blind slot information to change the service level.

2. Claim : 13

   Distributing available power evenly through the time that remains until the next recharge.

3. Claims: 15-17

   Changing the level of service based on RSSI.

Please note that all inventions mentioned under item 1, although not necessarily linked by a common inventive concept, could be searched without effort justifying an additional fee.

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte al Application No
PCT/EP 00/03754

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